IN THE UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF OKLAHOMA

W.A. DREW EDMONDSON, in his capacity as ATTORNEY GENERAL OF THE STATE OF OKLAHOMA and OKLAHOMA SECRETARY OF THE ENVIRONMENT, C. MILES TOLBERT in his capacity as the TRUSTEE FOR NATURAL RESOURCES FOR THE STATE OF OKLAHOMA,

Plaintiff,

vs.

TYSON FOODS, INC., et al.,

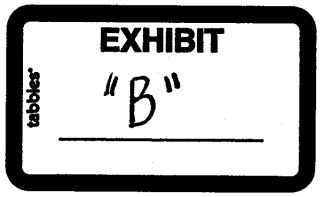
Defendants.

4:95-CV-003290-TCK-SAJ

(VOLUME I)

- -

VOLUME I OF THE VIDEO DEPOSITION OF BRIAN MURPHY, Ph.D., produced as a witness on behalf of the Defendants in the above styled and numbered cause, taken on the 25th day of March, 2009, in the City of Tulsa, County of Tulsa, State of Oklahoma, before me, Karla E. Barrow, a Certified Shorthand Reporter, duly certified under and by virtue of the laws of the State of Oklahoma.



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VIDEOGRAPHER: MR. DEREK ANDERSON

ALSO PRESENT: DR. ROGER OLSEN 09:03:16

I N D E X

WITNESS PAGE

BRIAN MURPHY, Ph.D.
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(Whereupon, the deposition began at 9:07 a.m.)

VIDEOGRAPHER: We are now on the record for the deposition of Dr. Brian Murphy. Today is March 25th, 2009. The time is 9:06 a.m. Counsel, 09:07:05
please identify yourselves for the record.

MR. PAGE: David Page, representing the State of Oklahoma, and with me is Dr. Roger Olsen.

MS. COLLINS: And Melissa Collins from Faegre & Benson on behalf of Cargill Turkey 09:07:12
Production and Cargill, Inc.

MS HILL: Theresa Hill on behalf of Cargill, Inc. and Cargill Turkey Production.

VIDEOGRAPHER: And on the phone?

MS. HILL: Vicki? 09:07:19

MS. BRONSON: Vicki Bronson for Simmons Foods.

VIDEOGRAPHER: Thank you. You may now swear in the witness.

BRIAN MURPHY, Ph.D., 09:07:22
being first duly sworn to tell the truth, the whole truth and nothing but the truth, testified as follows:

DIRECT EXAMINATION

BY MR. PAGE: 09:07:22

Q Good morning, Dr. Murphy.
A Good morning.
Q Would you give us your name and address, please?
A Brian Murphy, 2033, Suite 210, -- 2033 Wood 09:07:29
Street, Suite 210, Sarasota, Florida.
Q And have you ever given any sworn testimony like you're giving today?
A Yes, I have.
Q Okay. Would you please outline for us the 09:08:10
testimony you've given in the past and the type of work you were doing? What I'm really interested in is not any matters that would be involved in domestic or criminal or any kind of -- what I'm focusing on here is just your testimony where you've 09:08:21
operated as an expert witness.
A Well, I could give you more specifics looking at my resume.
Q Okay.
A Which outlines all the testimony. 09:08:26
Q Okay. Let's do that then. I've got a copy of your report, which has your resume or CV attached, and we'll mark that as Exhibit No. 1. What we'll do first is ask you if you would review that and tell me if that's a copy of your report. 09:09:06

PAH contamination, and the issue was which of the successive owners had contributed the contamination and to what degree. It was an allocation case.

Q And what analysis did you employ to do your work in that case? 09:14:11

A I started with a multivariate analysis, and then after I saw what that was providing me, I did go into a different kind of analysis, which was basically a mass balance. I was able, through stoikiometry, to calculate how much lead and arsenic 09:14:19 each of the parties had contributed over time.

Q Was that -- when you say stoikiometry, were you talking about the mass balance approach in that case?

A Yes. 09:14:27

Q Do you find that mass balance is a probative line of evidence to determine sources of contamination?

A It can be.

Q And would you describe the multivariate process you employed in this phosphorus case? 09:15:04

A It was a principal component analysis based on a number of metals to see if there were differences on different locations on the site and the composition of the contamination. 09:15:13

Q And what were the media that you investigated in this particular instance?

A Soils and groundwater, and I believe some sediment samples, as well.

Q And when you did your PCA analysis, did you do your soils and groundwater analysis in the same runs as the same -- you combined the medias? 09:15:19

A I don't believe in that case that I did.

Q Why not?

A Well, I was really just trying to feel my way. 09:15:28 I find that principle component analysis is most useful for seeing what's going on in a site and not necessarily the best technique for explaining it to a judge or jury, and so I was really just trying to find my way, and my conclusion was that the 09:16:08 contamination was pretty uniform across the site. Wherever there was buried pyrite, you found this contamination.

Q What about in the groundwater?

A That was -- the contamination there was 09:16:14 downgradient of buried pyrite.

Q Were you able to establish any relationship between the groundwater contamination and the soils contamination that you investigated?

A Only that it was downgradient and it contained 09:16:20

arsenic and lead, which, again, were the contaminants of concern.

Q Did you issue a report in that case?

A Yes.

Q Would you have any objection to providing counsel a copy of that report to turn it over to me? 09:16:27

A I believe the case is in mediation. I believe the report is confidential.

Q Would you check into that, please?

A Sure. 09:17:03

Q Does the report contain your PCA analysis?

A No, it does not.

Q Why not?

A Because I didn't find that to be the most useful way to deliver my results. 09:17:11

Q Did you primarily rely upon both the evaluation of the contaminants and where they were located along with mass balance to reach your conclusions?

MS. COLLINS: Object to form. 09:17:21

A That's roughly correct, yes.

Q (By Mr. Page) Was there anything else that you used to -- employed to reach your conclusions in that case?

A Well, I did fingerprinting of some PAH samples 09:17:27

to see what their composition reflected.

Q Okay. What do you mean by fingerprinting?

A Looking at the individual PAHs and seeing whether they were characteristic of fuels or urban runoff or what. 09:18:06

Q Is that an effective method to evaluate source with PAHs, fingerprinting?

A It can be.

Q And why is that?

A Well, different fuels have a composition 09:18:12 that's different than urban runoff, which in turn has a composition that's different than manufactured gas plant waste, which is also where it's commonly used.

Q Is there published literature that identifies the fingerprints identified with those different sources? 09:18:22

A Yes, there is.

Q Is it also true that PAH fingerprinting analysis can be effective because the PAHs structurally tend to maintain their structure as it processes through the environment? 09:18:28

A Well, they do maintain their structure, but they don't move together through the environment. Different PAHs move at different rates, for example, 09:19:09

in groundwater.
Q But the fingerprint, so to speak, doesn't change once it leaves the soil and enters the groundwater when you have a PAH; is that correct?
A That is not correct because the fingerprint is composed of ratios of different PAHs, and since they move at different rates through the environment and biodegrade at different rates, also, the fingerprint changes throughout the environment. 09:19:16
Q So how does one determine whether the fingerprint from a soil contaminant PAH is also present in a groundwater PAH? 09:19:23
A Primarily by looking at the location of the groundwater contamination, the direction of groundwater, and the velocity of the groundwater, and seeing whether the fingerprint makes sense. For example, the higher ring PAHs will move more slowly in groundwater. So if you're finding a preponderance of them far from your supposed source, you know that doesn't look like it's coming from that source. 09:20:02 09:20:13
Q So you look at kind of a gradation of contaminants from the suspected release points to determine whether or not the release point is the source of those contaminants? 09:20:19

A You could do that, yes.
Q Is that a method that's commonly employed in environmental investigations of sources?
A I don't know how common it is. I've done it in one case. 09:20:26
Q Did you find it to be effective in that case?
A I did.
Q Could you give me a little bit of an explanation of how you employed mass balance in this particular phosphate case? 09:21:02
A The plant had a manufactured sulfuric acid through burning pyrite, which is an iron and sulfur compound, and we knew how much super phosphate they were making, we knew how much sulfuric acid you needed to add to the ore in order to produce that much super phosphate, and we knew how much pyrite you had to burn to produce that much sulfuric acid. And when you -- from that, you can calculate -- knowing the level of impurities of arsenic and lead in pyrite, you can calculate how much iron -- how much lead and arsenic were being generated and disposed of on-site during different time periods. 09:21:13 09:21:22
Q Was that mass balance used to identify which of several owners had contributed the most to the contamination? 09:21:28

A Yes.
Q Have you ever employed mass balance analysis for source determination in any other action?
A Well, it depends on how broadly you define mass balance. I have a number of cases where I've estimated emissions to air, and then estimated what the resulting concentrations would be downwind, and in a sense, that's a mass balance. 09:22:15
Q Have you ever employed mass balance to get an understanding or a sense at a particular contamination site as to what the most likely significant contributors of a contaminant may be, and that's when you're investigating sources? 09:22:23
A I'm sure I have, but no case comes to mind.
Q Based on your experience with environmental forensics, do you find that that is probative or helpful in identifying the likely significant contributors of a contaminant to a site? 09:23:16
A It can be.
Q We were talking about your testimony before I got off on a little tangent there on mass balance. You've identified, I think, four pieces of testimony, the last one, I think was on phosphorus. In that particular case, did you give any court testimony? 09:23:26 09:24:09

A No.
Q Are there any other sworn testimony as an expert that are not on your resume that you can recall at this time, sir?
A Not that I can recall at this time. There may be, but I'd have to check. 09:24:14
Q Okay. So, now let's maybe refer to Page 19 of your CV, which is in Exhibit 1 to your deposition, and I see there's quite a few listed here, so if you could just name a party and give us a brief statement as to the issue you were investigating in that case, sir. 09:24:25
A The first one, the Hoffman case, involves a toxic tort where the claim was made that a person had been made to wash floors with trichloroethylene, and as a result, had become ill. And my role there was to estimate what levels of trichloroethylene he would have been exposed to. So in a sense, that's a mass balance case. 09:25:04
Q Did you employ traditional risk assessment exposure of techniques in your analysis? 09:25:15
A My part of the case was to calculate exposures, and someone else then translated those into health risks.
Q And that involved only the contaminant 09:25:22

Q I'm sorry to interrupt you there, sir. Was that the alleged polluter in that case?
A It was -- I think it was more a case of it was the present owner, and that the alleged pollution had occurred earlier prior to their ownership. 09:35:29
Q On the present owners' premises?
A Yes.
Q Okay, sir. The next case, LILCO?
A LILCO versus Alliance Underwriters was a -- involved disposal of transformers at a junkyard, and 09:36:06 the extent to which LILCO's transformers had introduced the PCB contamination that was found there.
Q And so PCBs were the chemicals of concern at that site? 09:36:17
A Yes.
Q And who did you represent?
A The insurers.
Q Was it an insurance coverage claim, sir?
A Yes. 09:36:21
Q And in that case, what analysis did you employ to determine the source of the PCBs?
A Actually, that's a mass balance case because what I did was I looked at how many transformers and what size had been disposed there, looked at what 09:36:28

the typical content would have been, and then compared that mass of PCBs with the mass that was actually found on-site.
Q And what did you determine?
A That LILCO had disposed of only a very small 09:37:04 portion of the PCBs that had been found on-site.
Q And that was based on analysis of the PCBs on-site versus what you were able to calculate they would have disposed based on the, I guess the transformers that they employed and disposed there? 09:37:14
A Yes.
Q Did you also look at other sources of PCBs as part of your mass balance?
A Not as part of the mass balances. I did look at some of the other sources of PCBs that were 09:37:21 on-site.
Q Did you employ any other analysis other than the mass balance analysis that you've described so far?
A I don't recall that I did. 09:37:25
Q Did you employ any PCA analysis in that case, sir?
A Not in that case.
Q Any fingerprint analysis for the PCBs?
A I think I looked at what the aroclors were 09:38:01

that were being found on-site and whether they were consistent with what LILCO used in their transformers.
Q And what did you determine?
A Well, again, my determination was that LILCO 09:38:08 had contributed very little to what was found on-site.
Q Okay, sir. Can you go to the next, James Barnett case, please, sir?
A Right. 09:38:14
Q And give us a description of that case, please, sir.
A That's actually one of a series of cases all at the Brio site in Friendswood, Texas, and in each of those cases the issue is the same. It's buried 09:38:24 tars in the ground. They were actually stored in pits, and then the theory was that the volatile compounds were emitted from the pits and drifted over into a near neighborhood.
Q Was it an air contamination case? 09:39:03
A Yes.
Q And what were the contaminants of concern there, sir?
A They were various products from vinyl chloride tars and styrene tars, including vinyl chloride 09:39:09

monomer, and I believe 1,2 dichloroethane.
Q Nasty stuff?
A Insufficient concentrations.
Q That's pretty much the same for everything, isn't it. Can you tell me, sir, in that case, did 09:39:15 you employ any PCA analysis?
A Not in that case.
Q And did you employ air modeling analysis for your investigation there?
A I did, and also emissions modeling. 09:39:21
Q What do you mean by emissions modeling?
A Well, the -- say the vinyl chloride monomer is contained in a tar, and so in order to estimate the release of monomer, you have to model its transport through the tar to the surface of the tar and then 09:40:02 through the soil.
Q And who did you represent in that case?
A Attorneys from Monsanto.
Q The alleged polluter in that case?
A Again, there was an issue as to whether they 09:40:10 had contributed at all or whether it was a prior owner.
Q Okay. We'll go to the next case, sir. That was a group of cases, they all had similar circumstances -- 09:40:17

at trial?
A I testified on when the plume -- when the release had occurred that formed the groundwater plume.
Q Okay. And was there a Daubert challenge in that case? 10:00:08
A No.
Q And would you go to the next one, sir?
A Testimony before an administrative law judge regarding expansion of Flying Cloud landfill. 10:00:11
Q Flying Cloud landfill. We haven't talked about that case before, have we, sir?
A No, we haven't.
Q What were the issues involved in that particular matter? 10:00:17
A There was a move to expand the landfill, but at the same time to install various control equipment, flare stacks and so on, and the issue was what would -- how would the resulting emissions and downwind concentrations compare after the expansion 10:00:23 with the current situation.
Q So your focus was on air contaminant transports?
A Yes.
Q Any PCA analysis in that case? 10:00:32

A Not in that case.
Q Okay. Next one, sir.
A The James Slaughter, et ux, is one of the Brio cases.
Q Okay. And the subject you testified at trial in that case? 10:01:06
A Emissions and downwind concentrations from pits in which styrene and vinyl chloride tars were stored. Also, I testified as to how the concentrations were measured in the neighborhood of 10:01:14 various air contaminants compared with concentrations elsewhere in Texas.
Q So your testimony at trial in that case concerned air emissions and their transport?
A And the air concentrations, yes. 10:01:21
Q Any Daubert challenge in that case?
A No.
Q And I recall there was no PCA in that case; correct?
A Not in that case. 10:01:25
Q And the last matter, sir?
A That involved a proposal to bring oil tankers into Puget Sound from Alaska, and my role was to look at what an explosion of an oil tanker would look like in terms of the resulting damage. 10:02:06

Q That was before an administrative law judge?
A Yes.
Q Was there any PCA employed in that case?
A Not in that case.
Q Have you ever testified, either in deposition or trial prior to today, where your opinions -- expert opinions involved PCA analysis? 10:02:13
A I've testified at depositions where I had used PCA to reach my -- in part to reach my conclusions, but I wasn't deposed on the PCA analysis. 10:02:27
Q The only case that I recall from our just going through these was the phosphate fertilizer case where you said you employed PCA, but it didn't ultimately end up in your opinion; is that correct?
A That would be the only deposition. I do have 10:03:06 one other case, not including this one, where I used PCA analysis to reach my conclusions.
Q Is that identified in your CV that's before you, sir?
A It is identified. It's not in the depositions 10:03:11 and trials because it hasn't reached that stage yet.
Q Could you show us on the CV that's before you in Exhibit 1 that entry for that matter, sir?
A Well, I appear to have misspoken because it doesn't appear to have made it into this version of 10:03:32

my CV, which is an older version.
Q Okay. Would you just describe that particular matter for us, sir?
A It involves contamination at a location in Maine, in a harbor in Maine, and the issue was 10:04:04 whether the contamination results from a manufactured gas plant that's located not too far away, whether it results from historical coal storage along the river front and/or whether it results from some other type of source. 10:04:15
Q What are the chemicals of concern?
A The chemicals of concern are various tars containing PAHs, as well as mono-cyclic compounds such as benzine.
Q And what media has been contaminated? 10:04:23
A Sediments in the river, as well as soils, but I believe a remediation is mostly of the sediments in the river.
Q And how did you employ PCA in your analysis in that case? 10:05:01
A I looked at the fingerprint of the various locations, locations associated with the manufactured gas plant, locations associated with the -- a historic pipeline leading down to the harbor, looked at the fingerprint in the sediments, 10:05:10

as well as in the soils.
Q Did your PCA involve more than one media?
A It did, although not at the same time.
Q Okay. So you did a separate, let's say, liquids media PCA from a solids media PCA? 10:05:20
A Yes.
Q Why did you not combine them together in that case?
A Well, because the fingerprint isn't preserved going from one medium to another. Again, different 10:05:26 PAHs have different transport properties in the environment.
MR. PAGE: Let's take a break.
VIDEOGRAPHER: We are going off the record. The time is now 10:05 a.m. 10:06:04
(Following a short recess at 10:06 a.m., proceedings continued on the record at 10:27 a.m.)
VIDEOGRAPHER: We are back on the record. The time is 10:26 a.m.
Q (By Mr. Page) Dr. Murphy, before the break, we were discussing some of your past experiences professionally, and my recollection is is that what you testified so far, and if you would confirm this, you employed PCA on two occasions that we've talked about, one at the phosphorus plant and one involving 10:27:07 10:27:18

a gas plant releases in a Maine harbor; is that correct?
A In addition to this case, yes.
Q Okay. So in all of your professional career, if you include this case, you've used PCA in your investigations three times? 10:27:27
A On specific cases, yes.
Q What about -- I want to make sure we're speaking the same language, so to speak. Have you employed PCA in any other professional investigations, may not have been associated with litigation or a case, other than what you've testified to so far today? 10:28:07
A Oh, I've edited a textbook that has a chapter on PCA, and I did edit that chapter and made various 10:28:14 corrections, so that's part of my professional work, also.
Q Okay. Any other source investigations where you may not have been involved in litigation, but you employed PCA to determine or help identify the sources of contamination in the environment? 10:28:21
A Not that I can recall at this time.
Q And is it fair for me to understand that in the two cases prior to the present case, when you employed PCA, you did not use the multimedia PCA 10:29:04

evaluation that you employed in Section 5 of your report for this case?
A That's my recollection.
Q I want to ask you a few more questions on your CV, sir, which is Exhibit 1. If you would turn back to that, I just have a couple of more questions, I think, on that. If you turn to Page 7 of your CV that's part of Exhibit 1, I think this is under your writings or your publications section, and there's an entry here, it's the fourth entry down, says, Murphy BL, I assume that's you? 10:29:15 10:30:01
A Yes.
Q As the principal author, and it says, mathematical modeling, physical science issues in natural resource damage assessment. Did I read that correctly, sir? 10:30:08
A Yes.
Q Okay. Could you describe briefly what the work you did in that particular presentation?
A My -- that was a long time ago and so my recollection may not be complete, but my recollection is that the mathematic modeling involved was involved in describing the transport of materials from compartment to compartment, each compartment representing a different environmental 10:30:14 10:30:22

medium.
Q And why is that important, sir?
A Well, very often you want to make a connection between a source and a receptor that's of concern, and in order to do that properly, you need to have 10:31:01 both the source and the receptor in your model, and you need to be able to talk about how things transform or change as you go from compartment to compartment in order to make that connection.
Q And did this involve the chemical changes in the constituents of concern, is that what you're talking about? 10:31:10
A That's my recollection, yes.
Q I'm going to go to the next one I've identified I'd like to ask a question about, sir, it's a couple of pages forward on Page 10, about halfway down the page, 1, 2, 3, 4, 5, 6, sixth entry where it says, estimated chemical emissions, including metals and dioxins in Muskogee, Oklahoma; do you see that? 10:31:18 10:31:29
A Yes.
Q Would you describe that circumstance for us?
A That was an NPDES suit. I was retained by the Department of Justice, and the issue was the dioxins and furans that were being generated by wire burning 10:32:06

and their transport off-site and into nearby bodies of water. It -- my role, in addition to doing the modeling, was also to collect some samples and have them analyzed for dioxins and furans.

Q And where did you collect the samples? 10:32:19

A On-site, near the wire burning operation.

Q Were they in the soils on-site?

A They were in the soils, yes.

Q Did you do any sampling in the water bodies that were associated with the NPDES discharge? 10:32:28

A I did not.

Q If we could go forward, sir, to Page 12 of your CV, there's an entry towards the bottom of the page says, metal inorganics, and the first entry says, performed statistical analysis to identify 10:33:10 **sources of lead and arsenic at a Mid-Atlantic phosphate plant. Is that investigation that's described there on Page 12 the one that we discussed earlier this morning concerning your phosphate analysis?** 10:33:18

A Yes, it is.

Q Okay. If you would go forward now, sir, to -- let's see -- would you look at Page 15 of your CV, sir. Under solvents, the second entry, would you read that, please? 10:34:08

A Analyzed how and when chlorinated solvents entered the environment at a Kansas manufacturing facility.

Q Could you briefly describe the analysis you employed in that particular evaluation? 10:34:14

A In that particular case, there were a series of buildings that were built, one after another, and as each building was built, a degreaser was moved and the location where solvents were stored was changed, and we had the date of the buildings, and 10:34:24 so by identifying the source of various plumes, which building they emanated from, we were able to date the releases from each building.

In that case, I used what I call the plume reconstruction method, which is adding back the 10:35:02 daughter products to the parent product, and we also used an anisotropic creaking to try -- to describe the plumes, and we were able to get definite plumes coming from each of -- from different buildings.

Q Not necessarily in that case, sir, but in 10:35:13 **other environmental investigations, is it generally important in source identification to be able to identify where the release occurred?**

A I would say that's generally the case.

Q And that same page on Page 15, sir, I want to 10:35:25

go down under solvents, 1, the fifth down, that was the Nebraska facility. Was that the same facility that we discussed earlier as part of your deposition testimony involving TCE and 1,1,1-trichloroethane?

A That's the same case, yes. 10:36:07

Q And that's where you talked about using mass balance already; right?

A Yes, sir.

Q All right, sir. Next page, the second from the bottom on Page 16 of your CV, it involves a 10:36:15 **Camden, New Jersey, site?**

A Yes.

Q It says there, to determine the source of the contamination, both mass balance estimates and groundwater modeling were used. Would you please 10:36:23 **describe the mass balance analysis you employed in that case?**

A My recollection is that one of the issues was whether an electroplating facility had contributed to contamination of a nearby well field, and we were 10:37:01 able to estimate what the discharge of -- let's see, it was chromium and solvents were from that electroplating facility and see if it matched what was being found in the well field.

Q And could you tell me how mass balance was 10:37:11

employed, specifically?

A You compare the mass disposed with the mass contained at the present time in the well field and see if the two numbers make sense.

Q Okay. Did you do an evaluation in that 10:37:19 **particular mass balance of other potential sources for the chromium and the chlorinated solvents?**

A My recollection is that we did, but not in the same detail as the electroplating facility.

Q And was that mass balance analysis probative 10:37:28 **in that particular circumstance?**

A My recollection is that it was.

Q Where are you currently employed, Dr. Murphy?

A At Exponent.

Q And what is your title? 10:38:14

A Principal scientist.

Q What does that mean?

A That's the highest technical rank in our organization, and generally principals are also stockholders in the company. 10:38:21

Q Okay. And how are you compensated?

A I'm paid a salary, and I get an annual bonus.

Q Okay. And what is the basis for your bonuses?

A Oh, you know, it's never really been explained to me. 10:39:01

itself.
Q And you did this analysis after you submitted your report?
A I looked at that particular one after I submitted the report, yes. 10:54:29
Q Anything else?
A Well, the third opinion would be that he's looked at other possible sources, such as cattle manure and wastewater treatment plants and so on, but he hasn't looked at the most important other 10:55:04
source, and that is just native soils. It's clear to me that his edge of field samples are dominated by components of native soils, and he has no idea what the compound is because he's never done an SPLP sample on native soils without poultry litter, 10:55:12
without cattle manure, et cetera, just has no idea what background is.
Q Wouldn't the reference stream samples serve as a background for such an analysis?
A Not for the edge of field, no. 10:55:21
Q How would they be different?
A Well, the surface stream samples are going to be dominated by components that are dissolved in surface water or are, you know, found in surface water naturally, whereas the native soils analysis 10:56:02

is going to be dominated by components that are found in native soils, that are glommed particulates and so on.
Q Wouldn't the runoff of impacted native soils be representative of the leachate you would find in 10:56:12 the unimpacted streams?
A No. Again, the chemical signature changes going from medium to medium, and so looking at a stream, a reference stream is not going to do the same thing as looking at a reference soil. 10:56:21
Q Okay. But you were talking about looking at a leachate or a runoff from a reference soil; correct, sir?
A Yes.
Q Okay. And I understand how if you went from 10:56:26 the solids to the liquid medium medium that would -- could be a change, but I'm trying to understand. I thought your criticism was concerned with Dr. Olsen didn't look at runoff from a reference soil and compare it to the streams; is that correct? 10:57:05
A That is basically correct, yes.
Q So my question --
A Oh, not as compared to a stream, compare it to the edge of field samples.
Q Oh, so you would want the runoff from an 10:57:09

unimpacted field -- edge of field sample from unimpacted field to be compared to an edge of field sample from a poultry disposed field?
A That would be one example. Another example would be comparing an SPLP test on unimpacted soil 10:57:17
with an SPLP test on supposedly poultry litter impacted soil.
Q So I guess what I'm trying to understand, then, Dr. Murphy, if we're talking about runoff from unimpacted soils that go into streams, how could 10:57:25 there be any chemical composition change in the sense that the unimpacted stream would not be representative of runoff from unimpacted soils?
A Well, first of all, it's a great deal of dilution that happens when you enter the stream. 10:58:05
Secondly, the partition in your variate chemicals is completely different, solid media and liquid media. It's controlled by things like solubility, like the soil water partitioning coefficient and so on, and so the chemical signatures, I'd say changes going 10:58:14
from medium to medium.
Q Have you done any evaluation in the IRW to demonstrate the opinion you just gave us?
A I have not attempted to find background in the IRW. 10:58:22

Q Did you perform any analysis, SPLP analysis on unimpacted soils?
A I have not done that at this date.
Q Have you done any collection and analysis of an edge of field sample on an unimpacted field? 10:58:28
A I have not.
Q So you wouldn't be able, then, to compare what you think may be running off of an unimpacted field to a reference stream to see if there is, in fact, any chemical changes? 10:59:08
A Well, again, my comparison is edge of field sample from unimpacted field, to edge of field sample from impacted field, or SPLP from native unimpacted soil to SPLP from soils that are impacted. Again, I'm not making a comparison of 10:59:18
stream to soil.
Q But I guess -- I guess the same question, though, a similar question is that you don't have the analysis to demonstrate your point, do you, sir?
A And neither does Dr. Olsen. As far as I know, 10:59:25
none of his measurements tell you what background is.
Q Background for an edge of field?
A Yes.
Q Did you do any investigation of the components 11:00:01

effectively, I think you've got to do a multimedia calculation. But that's not the only way to do it. You could do a --

Q Are you talking about -- let me just interrupt for a second, a multimedia PCA calculation, is that what you're saying? 11:50:02

A Yes, as I did.

Q Okay. Is there any -- okay. Anything else?

A You can do it just using your liquid samples, starting with SPLP for poultry litter and carrying it all the way through edge of field, groundwater, surface water. 11:50:08

Q Is your testimony that Dr. Olsen did not perform that analysis?

A I've never seen a scores plot for that. 11:50:14

Q Okay.

A In my multimedia analysis, the poultry litter samples look completely different than the surface water samples. They don't -- they don't look as if there's any relationship at all. 11:50:22

Q Can you -- can you account for that by some chemical process that may be going on?

A I think the processes are dilution and deposition. Whatever signal might be there is being masked by a native soil signal by the way chemicals 11:51:03

partition in water bodies, it just -- there's just no evidence of any effect from poultry litter.

Q Isn't it true, sir, that the same issues you had with chemical transformations of PAHs when you did your PCA analysis there would be similar issues you would have in the IRW with poultry waste? 11:51:14

MS. COLLINS: Object to form.

A I think the issue you're referring to is the way the different chemicals are transported in the environment. 11:51:23

Q (By Mr. Page) Yes, sir.

A And my conclusion from that is that to the extent that's true here, PCA is a very unsuitable technique to try to identify sources with because what's controlling this is not the sources. It's the differing transport and the fate of the different chemicals. Shouldn't have applied PCA analysis to this problem. 11:51:32

Q Other than your work in this particular case, can you provide any references for multimedia PCA analysis that you're suggesting? 11:52:08

A I think I give you a couple of references in the text to multimedia PCA.

Q You provide two; that's correct?

A Yes. I haven't tried to be exhaustive. I'm 11:52:14

sure I could come up with many more.

Q What were the chemicals of concern there?

MS. COLLINS: Page 30, sir.

A Yes, thank you. I -- in both cases there are dibenzodioxins and dibenzofurans. 11:53:23

Q (By Mr. Page) Can you identify any multimedia investigation where the contaminants of concern were nutrients?

A Not nutrients, but I know other people at Exponent have done multimedia for various metals. 11:53:32

Q What else, as far as your summary of your opinions?

A In the multimedia analysis, the edge of field samples from pastures with cattle but no poultry litter don't look any different than the edge of field samples where poultry litter has been applied. 11:54:28

Q Were those cattle edge of field samples actually edge of field samples, runoff samples?

A This may be the case where one of the samples was actually not at the edge of the field, but upstream from the field, and the other one was from a ponded location. 11:55:08

Q So did you actually critique those as not being representative of edge of field in the report?

A I believe I did. 11:55:19

Q Were those on the Pike property, sir, do you recall?

A Yes, they are.

Q So is it still your opinion that those samples from the Pike property are not representative of edge of field runoff samples? 11:55:24

A They are representative of samples that are -- were collected, liquid samples that were collected from locations where cattle were present, but not poultry. 11:56:03

Q Are they representative of runoff samples, sir?

A One of them would be -- well, they both probably are, because what that ponded water represents is remnants of runoff. 11:56:09

Q Are you aware of any information that indicates that those samples have been impacted by poultry contamination?

MS. COLLINS: Object to form.

A Not as I sit here, no. 11:56:16

Q (By Mr. Page) Anything else, sir?

A I think we've covered everything.

Q I want to make sure I understand the scope of your work in this case, Dr. Murphy. Did you perform your own investigation as to sources of bacteria in 11:57:03

matter?
A Similar subject matter, looking at Dr. Olsen's PCA and did it tell the story in successive towns.
Q Is it your position that that's not part of -- should be considered part of the considered materials for this work that was done? 02:25:14
A No, I --
MS. COLLIN: No, that's not our position. In fact, the second set of considered materials includes all of his work in that first phase of the project related to the facts or opinions in his ultimate report. 02:25:19
MR. PAGE: So that was the additional considered materials that were provided?
MS. COLLINS: Correct 02:25:25
MR. PAGE: About a week or two ago?
MS. COLLINS: That's correct.
Q (By Mr. Page) Did anyone review your expert report?
A Steve Mudge did. 02:26:06
Q Did he provide you any comments?
A He provided me -- yes, he provided me with some comments.
Q In what form; were they verbal or written?
A They would have either been by phone or by 02:26:12

e-mail.
Q Okay. Did you make a record of those comments?
A No, I simply incorporated them into my report.
Q So -- 02:26:22
A And the e-mails, if they exist, were turned over.
Q Okay. So Dr. Mudge comments you did accept and make the revisions pursuant to --
A Some of them I did, yes. 02:26:27
Q Do you recall what comments he made?
A The comment about using sterols was his comment.
Q He was the one who came up with the possibility of sterols -- 02:27:05
A Yes, he said, why -- why is he doing this analysis based on things that are found in soil? He said, why not use things that are found in animals, like sterols.
Q Okay. And so it was Dr. Mudge who made the suggestion that you might be able to distinguish poultry waste from soils with sterols? 02:27:11
A That was an example, yes.
Q Okay. Anything else?
A He suggested using a specific figure which 02:27:18

shows a three-dimensional view of PCA analysis that he's used in some of his reports, and I think he may have been using it in a book chapter that he thought helped explain what PCA was, and I chose not to use that. 02:27:29
Q Did you get -- did you ever prepare such a 3-D view?
A I have not, no.
Q And why did you choose not to use that?
A Well, I didn't think that it helped that much in explaining what PCA is. 02:28:04
Q Okay. Anything else?
A No. I asked him at one point could he point me to some multimedia PCAs, and he gave me a lead which I didn't follow up. I found -- I had papers in my office already that did multimedia PCA, so I used those as references instead. 02:28:17
Q Were you having a hard time finding multimedia PCA examples?
A No, but, you know, I thought since I had access to them, I'd see what he had to say. Like I say, I found these papers in my own files. I already had them. 02:28:26
Q Anything else, any comment on them?
A That's all I recall. 02:29:03

Q I'm going to hand you what's marked as Exhibit No. 4 to your deposition. Can you identify that for us, please, sir?
A It's e-mails between Dr. Mudge and myself.
Q Okay. I think I tried to put them in chronological order. Is this first e-mail where you just mention that you were looking for some examples of multimedia PCA? 02:30:07
A Yes.
Q These both waters and solids? 02:30:14
A Yes.
Q You've performed PCA in your work three times; correct, sir?
A Three different cases, yes.
Q And in two of those cases, you employed -- you separated water from solids; correct? 02:30:19
A That's correct.
Q And only in this case is where you did -- you put them together, the water and the solids together; correct? 02:30:26
A That's correct.
Q The second page is an e-mail from you to Stephen Mudge. Is this where you request him to do the peer review?
A Yes. 02:31:03

paragraph on Page 241?
A In any good EF case, it is necessary to ID a range of potential sources, their proposed pathways, and the receptor sites. I assume this was done in the CSM. 02:47:04
Q Would you stop there, sir? What do you mean EF case?
A Environmental forensics.
Q Okay. And was that done by Dr. Olsen in this case? 02:47:10
A I don't believe so, no.
Q You don't believe so?
A No, I'm sure it wasn't. He did his own PC analysis, but none of the other things.
Q Okay. So when Mr. Mudge says it's necessary 02:47:14 to ID a range of potential sources, their proposed pathways and the receptor sites, I assume this was done in the CSM, do you know what Dr. Mudge is referring to?
A I believe he's referring to the work done by 02:47:24 CDM.
Q And what does CSM stand for? Does that stand for conceptual site model?
A Yes, I believe it does.
Q Okay. So did Dr. Olsen, with CDM's 02:48:05

assistance, prepare a conceptual site model for this case?
A My recollection is he did.
Q And did that conceptual site model identify a range of potential sources, the proposed pathways 02:48:10 and receptor sites?
A Not all the potential sources, but some, yes.
Q Do you know how Dr. Olsen selected the potential sources?
A Well, he selected poultry litter because he 02:48:16 believed from the start that that was the important source. He selected cattle manure because that seemed unavoidable, that everybody knew there were cattle in these poultry field, applicated fields. The wastewater treatment plants, I don't know why he 02:48:29 focused on those, but -- and I don't know why he neglected native soils as a source.
Q Okay. Dr. Murphy, did you review any of the mass balance work that was performed by Doctors Engel and Meagan Smith in this case? 02:49:08
A I don't recall doing so.
Q Did you -- does it help your recollection to know that they did mass balance work for sources of phosphorus in the IRW?
A I recall that somebody did some comparison 02:49:15

between cattle and -- and poultry litter. I don't recall if the analysis included wastewater treatment plants or not.
Q Or other sources beyond that, also?
A Or other sources. I don't believe it included 02:49:22 native soils.
Q Do you know whether or not there was an analysis done in this case -- mass balance analysis for sources of bacteria?
A I don't know. 02:50:04
Q Would you read the next sentence, please?
A If this was the driver for the collection of data and samples for the PCA, as indicated in the Olsen report, why did they not use more specific markers for fecal material derived from poultry. 02:50:16
Q Okay. Did Dr. Mudge review the site conceptual model in this case?
A I sent him key sections of Olsen's report, and I'm not sure if that was one of the sections I sent or not. 02:50:25
Q Did Dr. Mudge have the mass balance work that was performed by the other experts for the State in this case?
A I sent him only Olsen materials.
Q Okay. Did you review any of the runoff 02:51:01

modeling work in this case.
MS. COLLINS: Object to form.
Q (By Mr. Page) Performed by the State?
A It would refresh my memory if you told me who it was by. 02:51:08
Q Dr. Engel.
A No.
Q Did Dr. Mudge have that available?
A I didn't send it to him, so the answer is no.
Q Okay. Would you read the next sentence, 02:51:13 please?
A The most sensible approach I would have thought was to analyze and assess for range of sterols and a few other key organic compounds.
Q Did Dr. Mudge ever tell you what the other key 02:51:23 organic compounds would be?
A I never asked and he never told me, but the idea is clear. You look for things that are symptomatic of poultry or at least living creatures.
Q Do you know whether or not sterols from 02:51:32 poultry would be any different from sterols from humans?
A I have not investigated that.
Q Do you know whether or not sterols from poultry would be any different from sterols from 02:52:03

know, we had the earlier discussion about transporting particulate matter as well, so solubles phosphorus doesn't cover everything.

Q (By Mr. Page) So it's your opinion, sir, that particulates on the land would also transport into the adjacent rivers and streams? 03:24:08

MS. COLLINS: Object to form.

A I think that's likely, yes. There's going to be erosion both from land and from river banks, particularly during high flow conditions. 03:24:16

Q And would you suppose, sir, that erosion or particulates from litter would be the -- would run off in land applied litter areas?

A I don't know what the relative proportions would be. 03:24:26

Q They would both likely run off in your scenario?

A It's possible for both to run off, yes.

Q Do you know whether or not -- and this may be redundant, I apologize for this, I just want to make sure I've covered it, do you know whether or not poultry waste is typically applied within a few miles of the poultry house where it's produced? 03:25:05

MS. COLLINS: Object to form.

A I don't believe I have any information on 03:25:12

where poultry waste was applied, and in saying that, I want to correct my early statement that Randy O'Boyle indicated to me where it was applied on the Cargill growers. He, in fact, did not. It was the poultry houses he identified for me. 03:25:21

Q And so you don't know, when you try to determine a downstream impact, whether or not the litter from those houses had been applied in the same areas those houses are located in?

A I don't know where the litter was applied. 03:25:28

Q In order to determine impact from Cargill operations, which is more important in your opinion, where the litter is land applied or where the chickens are grown?

MS. COLLINS: Object to form. 03:26:05

A They're turkeys, not chickens.

Q Where the poultry is grown?

MS. COLLINS: Same objection.

A Well, if the turkey litter is a source, a significant source, then you'd want to know where it's applied, and look downstream from that. The house, per se, is not a source. 03:26:12

Q It's still released from the house, as far as you're aware of?

A I haven't seen any discussed. 03:26:19

Q If there is a release from land application, if there is any release from poultry growing operations, it would more likely be where the land application is located; is that correct?

MS. COLLINS: Object to form. 03:26:26

A That seems reasonable to me, but I haven't looked into it.

Q (By Mr. Page) Have you evaluated the chemical composition of cattle waste?

A Only to the extent that it's in my PCA analysis. 03:27:09

Q You've not done any evaluation of the constituents compared to the poultry waste constituents to see if there are any differences?

A Only through the PCA analysis. 03:27:15

Q Did you compare the SPLP analysis between poultry and cattle?

A Only through the PC.

Q Did you ever look and see whether there's a difference in the leaching characteristics between poultry and cattle waste? 03:27:20

A Only through the PCA.

Q Can you tell us what your understanding of the native soils are in the IRW?

A I've seen them described as turkey soils. I 03:28:02

don't know the extent to which that applies, to the entire IRW or just a portion, but that's the description I've seen.

Q Okay. Do you know anything about the geological formations in the IRW? 03:28:09

A I know that it's a limestone and that it's a limestone that has gaps in it, fractures and pits and so on.

Q In your experience, would such a geological formation be conducive to infiltration of water in subsoil areas? 03:28:17

A It could be.

Q Have you heard -- have you -- have you heard the IRW geology to be referred to as a mantled Karst? 03:28:28

A I've heard the Karst part of it. I don't know if I've heard the phrase mantled Karst.

Q What is Karst, sir?

A Karst is the situation I just described of limestone that's fractured, punctured and so on. 03:29:02

Q Would turkey soil facilitate runoff?

A Probably not as much as some other soils.

Q Which soils would have greater runoff in your opinion than turkey soils?

A I think high organic soils, farming soils. 03:29:14

runoff, septic tanks, et cetera, to the same degree as other locations.
Q Would you stop there, please, sir? Do you know whether or not any such locations exist that could be sampled within the IRW? 04:00:28
A I have not investigated that.
Q And why would it be important in your mind to evaluate as a reference condition an area that's unaffected by poultry litter but affected by other factors such as wastewater treatment plants? 04:01:06
A To find out what background is.
Q Couldn't you find out what background is by locating an area that has no sources whatsoever contributing to it?
A You could, particularly if you took edge of 04:01:15 field samples in those locations.
Q What about streams in those locations, do they also represent background in streams?
A They represent stream background, yes.
Q Do you know whether or not wastewater 04:01:23 **treatment plants, urban runoff or septic tanks are significant sources of phosphorus to the IRW rivers and streams?**
A I have not investigated that.
Q If a chemical of concern is phosphorus, would 04:02:01

that information be important to how you construct your evaluation as to source contributions?
A Not from my evaluation, which is strictly in the context of principal component analysis. Someone else could do that evaluation. 04:02:11
Q Would that be important, based on your knowledge of environmental forensics, for determining source?
A It could be.
Q Isn't it true, sir, that principal component 04:02:17 **analysis, the best types of samples are those that are ambient water samples from which you can determine, or sources based on the ambient waters themselves?**
A I either don't understand the question or I'm 04:02:29 drawing a complete blank on the answer.
Q Would you agree, sir, that in environmental forensics investigations, the investigator rarely has a priori knowledge of all sources?
MS. COLLINS: Object to form. 04:04:13
MR. ELROD: Object to the word a priori.
A It sounds like you're quoting from something written by Glenn Johnson. I'd have to see the statement in its full content, but I don't disagree with that statement. 04:04:23

Q (By Mr. Page) Okay. Would you also agree that you would like to derive source patterns directly from analysis of ambient data?
MS. COLLINS: Object to form.
Q (By Mr. Page) In the context of principal 04:05:01 **components analysis?**
A Well, again, Glenn's chapter is about more than principal component analysis, it's also about polytopic vector analysis and other methods where you can identify sources directly from the data. 04:05:09 Principal component analysis, you can't.
Q You can identify groups of samples that appear to be related to the same source; correct, principal component analysis?
A You can identify groups of samples that behave 04:05:17 as if they were -- or analytes that behave as if they were coming from the same source.
Q And that would be a piece of evidence to determine source identification and evaluation, would it not? 04:05:23
A It could be a piece of evidence, yes.
Q Let me hand you what's been marked as Murphy Exhibit 8, and I can tell you, Dr. Murphy, that these are pages from Dr. Engel's expert report in this case. Have you testified you have reviewed Dr. 04:06:17

Engel's report?
A I testified that I had not.
Q I thought it was listed in your considered materials in this case; was I mistaken?
A I think I received it, but I didn't -- I don't 04:06:24 recall reviewing it.
MS. COLLINS: I don't think so.
Q (By Mr. Page) You don't recall reviewing it, sir?
A I do not. 04:07:05
Q Let me ask you this, sir. Would you turn to the third page, which is a pie chart. Could you identify what Dr. Engel has identified as mass balance as the leading sources of phosphorus in the IRW? 04:07:15
A He identifies the leading source as poultry.
Q By review of this -- would this type of information in this pie chart help you determine which sources you should evaluate through a PCA?
A I think before I did that, I'd want to look at 04:07:27 the information and see if it's correct.
Q Okay. Let's assume it's correct.
A If we assume it's correct, then I would say that poultry would be a reasonable thing to look at. You should look at other sources, too, but that 04:08:05

would one that shouldn't be overlooked.
Q Based on this information in Exhibit 8, are there any other sources that you would feel important to look at in an evaluation of PCA?
MS. COLLINS: You're limiting his answer to sources reflected in this document? 04:08:12
MR. PAGE: Yes.
A Okay. So I won't mention native soils, then, since it's not reflected here. Commercial fertilizer shows up in his pie chart, dairy cattle show up, human, which I imagine is wastewater treatment plants but I don't really know, or maybe septic tanks, those seem to be the other major sources in his pie chart. Whether they are in reality or not, I don't know. 04:08:18 04:08:32
Q (By Mr. Page) If those sources are in fact significant contributors, would you expect to find a pattern in a PCA analysis of ambient waters in the watershed?
MS. COLLINS: Object to form. 04:09:08
A You're always going to find a pattern in a PCA analysis.
Q (By Mr. Page) Would they be identified as a significant PC if they were significant sources of contamination? 04:09:14

A Not if you're -- well, if you're just looking at ambient waters, it's hard for me to see how PC analysis can identify sources. You're going to have to look at sources, too.
Q Wouldn't the ambient waters, if you did a PCA analysis of ambient waters, wouldn't it be able to determine, based on principal components it identified, separate groups of samples that were contaminated by a similar source? 04:09:32
A It would show you which sources are related -- which samples are related to which other samples. It would tell you which chemicals behave as if they had a common source, but it wouldn't tell you what that source is. 04:10:10
Q Okay. And would you expect that if there was a source in the IRW that was a very small contributor to contaminants, would you expect that to have an influence that you could see in a PCA analysis? 04:10:17
MS. COLLINS: Object to form. 04:10:28
A Well, it could be a small contributor for phosphorus, which is only one analyte, and your PC analysis typically has 20, 30 analytes, so it could be a major contributor for those other analytes. You can't do a PC analysis on one analyte. 04:11:04

Q I didn't suggest that.
A Okay.
Q What I'm suggesting is that if a particular source in the -- a source of contamination in the IRW contributes very few contaminants, would you expect to see that source -- a PC identify with that source in your PCA? 04:11:11
MS. COLLINS: Object to form.
A I would not find a PC identified with any source because to me, principal components do not represent sources. They are totally mathematical constructs. They don't represent sources. 04:11:19
Q (By Mr. Page) Would you expect to see a PC associated with a source that had very few contaminants contributed? 04:11:26
MS. COLLINS: Object to form.
A I'm not sure I know what associated with means either. PC can tell you what samples are related to what other samples, that is, have the same signature, and it can tell you what analytes behave as if they had a common source, but it doesn't identify sources. 04:12:07
Q (By Mr. Page) Would you expect to find a signature, a PC signature, a term you just used, for a contaminant source that contributes very minimal 04:12:13

contaminants to the ambient waters?
MS. COLLINS: Object to form.
A It's possible because PC is about variability, not about total concentration.
Q (By Mr. Page) Can total concentration affect variability? 04:12:21
A It can.
Q Did you have any mass balance information available to you for your evaluation, sir?
MS. COLLINS: Object to form. 04:13:09
A I don't recall. I certainly didn't use any mass balance information. I don't recall seeing any.
Q (By Mr. Page) Did you have any modeling information available to you, sir, that is a runoff model? 04:13:18
A I suppose it was available to me in the sense that I had access to Dr. Engel's report, but it wasn't germane to what I was doing.
Q Is that because you're simply focusing on PCA? 04:13:26
A And the specific measurements that were taken at the Cargill growers, focusing on two things.
Q Would the mass balance information that's available in Exhibit 8 help you to do an evaluation of potential sources in the IRW? 04:14:05

MS. COLLINS: Object to form.
A It could if it's correct, but I have no idea if it's correct or not.
Q (By Mr. Page) Could it help you interpret PCA results for the IRW? 04:14:11
MS. COLLINS: Object to form.
A It's conceivable. I don't know what the report looks like. And in the absence of any information, I can't reject it out of hand.
Q (By Mr. Page) Let me hand you what's been marked as Exhibit 9. Can you identify that, sir? 04:14:24
A It's selected pages from a book that I edited called Introduction to Environmental Forensics, Second Edition.
Q And Chapter 7 is entitled what, sir? 04:16:05
A Principal components analysis and receptor models in environmental forensics.
Q Okay. I selected a page from that report, sir, it's Page 234, it's the next page following that chapter heading. 04:16:15
A Right.
Q Would you read the first two sentences -- excuse me, three sentences of the second full paragraph on page 234?
A In assumption of the conceptual mixing 04:16:20

models --
Q I'm sorry, the next paragraph.
A After the choice of K, see section 724, the receptor model then resolves the chemical composition of sources F, and the contribution of 04:16:26 the sources in each of the samples A. Recall, however, that in environmental forensics investigations, we rarely have a priori knowledge of all sources. If possible, we would like to derive source patterns directly from the analysis of 04:17:02 ambient data.
Q Could you stop there? Do you know what the author means by if possible, we would like derive source patterns directly from analysis of ambient data? 04:17:09
A This is in his section on self-training receptor modeling methods. It's not about PCA. PCA is described in earlier pages, 214 through 232, so this is in the context of things like polytopic vector analysis. What he's saying, within the 04:17:17 context of the measurements themselves, you can determine how many sources there are, what the composition of the sources is, and how much each source is contributing to each measurement, and you do that by relaxing some of the constraints on PCA. 04:17:25

Q Can you derive source patterns in PCA?
A I don't believe so.
Q You don't believe you can?
A Not really, it's not set up to do that. It's constrained by having the PCs be orthogonal to 04:18:02 each other, and because of that constraint, the PCs don't generally correspond to sources.
Q Okay. Can you -- do you agree that if possible, you would like to derive source patterns directly from analysis of ambient data, do you agree 04:18:10 with that statement?
A Yes.
Q With the PCA analysis, do you agree that that statement is applicable also to PCA analysis?
A Source patterns, but not determining sources. 04:18:18 That's why it's in this section of his chapter and not in the earlier PCA section.
Q So for PCA analysis, is it important to have a sample collection from all sources in order to do a PCA analysis? 04:19:03
MS. COLLINS: Object to form.
A I think that's generally the case, yes.
Q (By Mr. Page) So you think it's necessary to have a sample from all sources in order to do a PCA analysis? 04:19:11

A I would say it's useful. If your -- if your PC analysis is dominated by transport phenomena rather than by sources, it won't matter whether you have all sources or not because it will be simply how chemicals partition different ways in different 04:19:18 media.
Q Are you aware of investigators that have published peer review reports where they did not have samples for all the sources they were investigating? 04:19:25
A For a PCA analysis?
Q Yes.
A I'm not surprised, but I wouldn't think they could draw conclusions about the sources they hadn't investigated. 04:20:04
Q Could they not identify which components for a PC loaded the highest and then compare those loadings with what they knew about the constituents in a potential source?
A Again, loadings don't have to do with 04:20:16 concentrations, they have to do with what's contributing to variability.
Q Have you seen investigators in published reports on PCA, principal component analysis, evaluating loadings to determine sources? 04:20:25

IN THE UNITED STATES DISTRICT COURT FOR THE
NORTHERN DISTRICT OF OKLAHOMA

W. A. DREW EDMONDSON, in his capacity as ATTORNEY GENERAL OF THE STATE OF OKLAHOMA and OKLAHOMA SECRETARY OF THE ENVIRONMENT C. MILES TOLBERT, in his capacity as the TRUSTEE FOR NATURAL RESOURCES FOR THE STATE OF OKLAHOMA,	)
Plaintiff,	)
vs.	) 4:05-CV-00329-TCK-SAJ
TYSON FOODS, INC., et al,	)
Defendants.	)

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VOLUME II OF THE VIDEOTAPED DEPOSITION OF BRIAN MURPHY, PhD, produced as a witness on behalf of the Plaintiff in the above styled and numbered cause, taken on the 26th day of March, 2009, in the City of Tulsa, County of Tulsa, State of Oklahoma, before me, Lisa A. Steinmeyer, a Certified Shorthand Reporter, duly certified under and by virtue of the laws of the State of Oklahoma.

A On runoff, yes.
Q What about leaching?
A Well, of course, over time the leachate is going to spread the contamination downwards, and so after a long enough time it may very well be that the two to four is more significant than the zero to two because the soluble components have been transported downward. 08:59AM
Q So you'd want to take some look at the soluble components of interest and see if they've been transported, but generally, at least for current land application, the zero to two-inch layer would have the most impact on leaching? 08:59AM
A For fresher applications, yes.
Q So it -- wouldn't the zero to two-inch soils be the most applicable to determine effects on the environment from land application soils? 08:59AM
MS. COLLINS: Object to form.
A That would generally be the case, not in the context of PCA analysis necessarily, but as a general matter, yes. 09:00AM
Q Can we turn to Table 3-3 of your report, sir? I think it's on Page 22, sir. Would you explain Table 3-3 for the Record?
A Table 3-3 is based on information I received 09:01AM

from Randy O'Boyle, and it shows sample locations downstream or downgradient of the various Cargill contract growers.
Q Okay, and how were these sample locations selected? 09:01AM
A They were selected by Randy O'Boyle.
Q And what were the criteria?
A That they be downstream or downgradient of Cargill growers.
Q Was there any other criteria? 09:01AM
A Not that I'm aware of. I think the instructions were to be generous in deciding what was downstream or downgradient.
Q What do you mean by generous?
A Oh, if there was an issue as to whether something was downgradient. For example, if it was a little bit off the direction of groundwater flow, to still consider it downgradient, that a plume that was spreading could possibly impact that location. 09:01AM
Q What about for surface samples; what were the criteria? 09:02AM
A Again, just to be generous in deciding which surface samples were downstream or downgradient, downstream.
Q So you would look -- when you say generous, does that mean you would go farther distances away? 09:02AM

A No. These are -- these are nearby surface water, surface soil samples and -- or surface water or spring or sediment samples.
Q How do you -- I'm sorry. Finish, please. 09:02AM
A Exactly how far downstream they are, I'd have to ask Randy O'Boyle, but what we were trying to do is identify any place that could possibly have a Cargill impact and see if those stood out from other samples. 09:03AM
Q Stood out in what respect?
A Had a different PC signature.
Q Did you do any comparison with respect to concentrations of, for example, phosphorus, any of the water and the sediment? 09:03AM
A My analysis has been totally in the context of principal component analysis.
Q So the answer is no?
A That's correct.
Q What was -- what was your instructions to Mr. O'Boyle concerning trying to be near to the down -- I think the sampling location nearby? 09:03AM
A I don't recall I gave him instructions in terms of how near was near, you know, in terms of how many miles. 09:03AM

Q Would eleven miles be nearby?
A I'm not sure if it would or wouldn't.
Q Did he select the closest sampling location?
A I believe he tried to, yes.
Q Were these all -- were these all of the Cargill growing operations? 09:04AM
A That was the intention, yes.
Q So this represents all 35, Table 3-3?
A That was the intention.
Q Doesn't appear that there's 35 operations on this table, does it? 09:04AM
A No.
Q So can you tell us what's missing?
A I don't know which ones are missing. I think if you compare the list of Cargill contract growers here with the total list, you'd be able to see which ones are missing because the third column gives you the names of the growers. 09:04AM
Q Did you do that analysis?
A I did not. 09:04AM
Q Did your analysis consider whether Cargill poultry litter had been applied upgradient from any of these locations?
A Since I don't know the locations, and I don't believe Randy O'Boyle does either, where the actual 09:05AM

application was, they're -- they're downgradient or downstream of the houses.
Q So the answer is no?
A That's correct.
Q And did the analysis that you performed consider whether there was any other poultry litter from any of the other of the defendants upgradient from these locations? 09:05AM
A I don't believe it did.
Q Did it consider any of the timing of poultry litter application around or near these locations? 09:05AM
A I don't believe it did. It's strictly a spatial analysis.
Q We took a look at a couple of these to evaluate your criteria, Dr. Murphy. Let me hand you what's marked as Exhibit 19, and I can tell you that this is a map of the IRW. Do you recognize that, sir? 09:06AM
A Yes.
Q And do you recognize the Lester location here? 09:07AM
A I see it on the map, yes.
Q From your work, do you recognize that as being the location of the Lester grower for Cargill?
A I wouldn't be able to say yes or no.
Q Okay. Well, I'll represent to you that we 09:07AM

A Assuming everything you say is true, that would be correct.
Q What are the differences in phosphorus between the two sample locations?
MS. COLLINS: Object to form. 09:09AM
A The Spring 04 Anderson non-filtered has a phosphorus level of .69 milligrams per liter; whereas, the Spring Anderson has a phosphorus level of .014 milligrams per liter.
Q How far away from the Lester facility is the Spring Anderson, the location that's identified on Table 3-3 of your exhibit? 09:09AM
MS. COLLINS: Object to form.
A It looks like, based on the key from this map, and, again, assuming everything is accurate, perhaps 25 miles. 09:10AM
Q On Table 3-3 where you've got a notation for location, is that your -- is that your sample ID reference?
A It's the sample ID that I -- reference that I received from Randy O'Boyle and used to circle the various locations as being downstream or downgradient. 09:10AM
Q Did you check any of his work?
A I have not. 09:10AM

identified that, and best of my knowledge it's been properly identified. Is Lester one of the people that you've looked at as part of your analysis on Page 22, Table 3-3?
A Lester appears on Table 3-3. 09:08AM
Q Okay, and what is the spring ID that you looked at?
A The spring is Anderson spring.
Q Okay. Where does the Anderson spring ID show up on this map at Exhibit 19? 09:08AM
A Well, again, I can't vouch for the accuracy of the map, but it certainly is not the closest location.
Q In fact, there was another one called Spring 04 that would be closer; correct, sir? 09:08AM
MS. COLLINS: Objection.
A Yes. It's -- the sample ID is also Anderson, however. So it's unclear to me which location is being used. They're both Anderson.
Q Okay. If in fact, you used sample ID Spring Anderson, which is shown on the Oklahoma portion, you'll admit to me, sir, if that's accurately shown, that you did not select the closest spring to the Lester facility as part of your analysis? 09:08AM
MS. COLLINS: Object to form. 09:09AM

Q Just let me look at one other example. Let me hand you what's marked as Exhibit 20, sir. Sir, this is a GIS picture of -- within the IRW showing the Edwards facility, and then sample locations that would be downgradient from the facility, along with their sample IDs, and also the results from samples taken from those locations. 09:11AM
MS. COLLINS: Object to form. Object to the use of this exhibit without providing the information that generated it. 09:11AM
MR. PAGE: I'll just represent to you this is information that was taken from information provided to the defendants during the course of the discovery of this case.
Q Can you identify on this map, sir, the sample location that you used for the Edwards facility? 09:12AM
A Well, assuming that it's what's given in Table 3-3, it would be SD 062.
Q Would you circle that on the exhibit, sir, please, in red? 09:12AM
A (Witness complied).
Q Okay. Is it the only sample location that's downgradient from Edwards?
A The map that you've provided, Exhibit 20, shows two other locations. 09:12AM

sources.
Q Okay, sir. Let me hand you what's been marked as Exhibit 32 and, sir, this is the corrected scores plot now but it's not the expanded view, so that's why the figure is a little different label at the bottom. It's 6.11-18D, and so this is after the log transformation has been corrected, and I want to ask you to do the same thing. Would you please draw a circle around the three different sources and label them? 01:51PM
MS. COLLINS: I repeat my standing objection from earlier as to the nature of this exhibit.
MR. PAGE: Save the speech and save the time. 01:51PM
MS. COLLINS: Also object to form.
Q Would you also label them, sir?
A (Witness complied).
Q And then the reference samples also?
A (Witness complied). 01:52PM
Q I don't believe you labeled the reference on Exhibit 31. Would you do that also for me?
A Yes.
Q Thank you, sir. Okay. Do the -- after you do the transformation, do you also find that there are 01:52PM

three separate groups for these three separate source categories?
MS. COLLINS: Object to form.
A Well, they're not really separate in that there's some other kinds of samples mixed in but 01:52PM they -- the figures I do -- I did draw do enclose or are in relative position to each other.
Q And so there's not an overlap between the different groups, is there?
A Not in either figure, no. 01:53PM
Q So is it fair to conclude that although unfortunate, the mathematical calculation did not affect Dr. Olsen's ability to interpret these scores plots?
MS. COLLINS: Object to form. 01:53PM
A This is the plot just for surface waters, and I'd need to see what the original and corrected versions looked like for the other runs, the SD 1 and so on.
Q But for the surface waters, would you -- 01:53PM
A For the surface water, the clustering is about the same.
Q So you could do the interpretation either way; correct?
MS. COLLINS: Object to form. 01:53PM

A Yeah. Whether he did it correctly either way is a different issue.
Q On Page 30 of your report, Dr. Murphy, you reference a couple of examples by citing papers of successful use of multimedia PCA analysis; correct? 01:55PM
A Yes.
Q Do you know whether in all circumstances multimedia analysis is appropriate for PCA?
A No. I would say it's not going to be very useful when the patterns between contaminants change 01:55PM from media to media because of fate and transport differences.
Q Okay.
A At least it's not going to be useful for determining sources. It may be useful for defining 01:55PM fate and transport differences.
Q Well, if you can connect the source to the place where the transformation occurred, then you could still make that linkage, could you not?
MS. COLLINS: Object to form. 01:56PM
A You mean along the part of the pathway where are there are no differences?
Q Yeah.
A You could do an analysis on that part of the pathway. 01:56PM

MR. PAGE: Can we go off the Record a minute?
VIDEOGRAPHER: We are now off the Record. The time is 1:57 p.m.
(Following a short recess at 1:57 p.m., 01:57PM proceedings continued on the Record at 2:03 p.m.)
VIDEOGRAPHER: We are back on the Record. The time is 2:03 p.m.
Q Dr. Murphy, I located a copy of the report I wanted to ask you about. Let me hand you Exhibit 33 02:03PM **and ask you to identify that for the Record.**
A It's a paper called Patterns and Sources of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans Found in Soil and Sediment Samples in Southern Mississippi. 02:03PM
Q And was this paper one of the ones that you cited as representative of multimedia analysis?
A I believe it is, yes.
Q Okay. Take a moment to take a look at it and I want to ask you a few questions. 02:04PM
A All right.
Q What were the multiple medias evaluated in this particular work?
A They're shown in Table 1. There's pulp mill effluent, which I take to be a liquid. There's 02:05PM